Proceedings of the American Academy of Arts and Sciences.

VOL. XXXIII. No. 27. — JULY, 1898.

(TITLE PAGE AND TABLE OF CONTENTS.)

PROCEEDINGS.

Eight hundred and ninety-first Meeting.

May 12, 1897. — ANNUAL MEETING.

The Academy met at the Jefferson Physical Laboratory of Harvard College, Cambridge.

The PRESIDENT in the chair.

The chair announced the death of Matthew Carey Lea, of Philadelphia, Associate Fellow.

The Corresponding Secretary read letters from Ludwig Boltzmann, Wilhelm Dörpfeld, and W. Pfeffer, acknowledging their election as Foreign Honorary Members; also a circular from the Academy of Natural Sciences of Philadelphia, calling attention to a proposed amendment to the regulations governing the mails of the Universal Postal Union.

The Corresponding Secretary read the Report of the Council.*

The Treasurer presented his annual report, of which the following is an abstract: —

GENERAL FUND.

Receipts.

Balance, May 1st, 1896			$2,115.68
Assessments	$920.00		
Sale of publications	163.62	$1,083.62	
Income from investments		4,718.21	
Return of bank tax		41.18	
Donations		105.00	5,948.01
			$8,063.69

* See Proceedings, Vol. XXXII. p. 331.

Expenditures.

General expenses	$2,027.75	
Publishing expenses	2,599.62	
Library expenses	1,475.09	$6,101.96
Balance, May 1st, 1897		1,961.73
		$8,063.69

Rumford Fund.

Receipts.

Balance, May 1st, 1896		$1,908.33
Income	$2,576.41	
Return of bank tax	96.08	2,672.49
		$4,580.82

Expenditures.

Books and binding	$53.22	
Publishing expenses	883.94	
Investigations	500.00	
Rent	10.00	$1,447.16
Balance, May 1st, 1897		3,133.66
		$4,580.82

Warren Fund.

Receipts.

Balance, May 1st, 1896	$614.89
Income	856.06
	$1,470.95

Expenditures.

Investigations	$600.00
Balance, May 1st, 1897	870.95
	$1,470.95

Building Fund.

Receipts.

Balance, May 1st, 1896	$288.68
Income	485.10
	$773.78
Balance, May 1st, 1897	$773.78

The Librarian presented his annual report, of which the following is an abstract: — 3,329 books and pamphlets have been added to the Library during the past year, 2,429 of which were obtained by gift and exchange, 687 purchased with the appropriation from the income of the General Fund, at a cost of $334.98, and 213 with the appropriation from the income of the Rumford Fund, at a cost of $23.92. During the year, 561 volumes were bound at an expense of $620.10, of which $26.80 was charged to the Rumford Fund. The total expenditure for books, periodicals, and binding amounted to $979.00 of which $50.72 was charged to the Rumford Fund. 180 books were borrowed from the Library by 31 persons, 20 of whom were Fellows of the Academy.

The following reports were also presented: —

Report of the Rumford Committee.

At a meeting, October 26, 1896, the Committee voted that the sum of $400 be put at the disposal of Professor Henry Crew, of Northwestern University, for investigations on the electrical, chemical, and thermal effects of the electric arc.

The sum of $100 was also voted to Mr. R. O. King, for investigations on the Thomson effect in metals.

John Trowbridge, *Chairman.*

May 12, 1897.

Report of the C. M. Warren Committee.

In behalf of the C. M. Warren Committee I have to report that during the past year a grant of six hundred dollars ($600) has been made to Professor C. F. Mabery, of Cleveland, Ohio, in aid of his investigations of the chemistry of petroleum; and a grant of two hundred dollars ($200) to Professor H. O. Hofman, of Boston, in aid of his investigation of the formation-temperatures of certain silica-iron-lime slags of metallurgical importance.

I have received from Professor F. C. Phillips a highly satisfactory "report of progress" concerning his researches on natural gas, in behalf of which a grant was made by the Academy year before last.

Professor Mabery's researches on petroleum have gone on steadily during the year, and several important papers relating to them have been published by him.

F. H. Storer, *Chairman.*

Report of the Committee of Publication.

During the past year two numbers of Vol. XII. of the Memoirs have been published, aggregating 296 pages and 26 plates, as well as the whole of Vol. XXXI. and fourteen numbers of Vol. XXXII. of the Proceedings aggregating 674 pages and 1 plate.

One Memoir and eight papers in the Proceedings have been paid for from the Rumford Fund, and two papers appeared in Vol. XXXI. of the Proceedings, at no cost to the Academy. From the Academy's general funds there have been expended $1,131.89 for Memoirs, and $1,467.73 for Proceedings, a total of $2599.62.

In May last the Academy appropriated from its general funds the sum of $2,300 for publications; at the December meeting there was added to this the sum of $461 (the direct subscription the previous year for the publication of Vol. XXXI. of the Proceedings), together with the proceeds from the sales of publications during the year, which have amounted to $163.62, giving a total appropriation of $2,924.62, and leaving an unexpended balance of $325.

The Committee hopes that to the usual annual appropriation of $1,800 this sum of $325 may be added.

A change has been made in the mode of publication of the Proceedings which insures a more prompt issue without adding to their cost.

Samuel H. Scudder,
Chairman.

On the recommendation of the Committee of Finance, it was

Voted, To make the following appropriations from the income of the General Fund for the ensuing year:

For general expenses	$2,000.00
For the Library	1,400,00
For publications	2,100,00

Voted, That the assessment for the ensuing year be five dollars.

Voted, That one thousand dollars ($1,000) from the income of the Rumford Fund be placed at the disposal of the Rumford Committee, to be expended in aid of investigations on Light and Heat, payments to be made on the order of the Chairman of the Committee.

On the recommendation of the C. M. Warren Committee it was

Voted, That the sum of six hundred dollars ($600) from the income of the C. M. Warren Fund be granted to Professor C. F. Mabery of Cleveland, Ohio, to aid him in continuing his researches on the chemistry of petroleum.

The Chair announced that H. E. Scudder and Roland Thaxter had asked to have their nominations for the Council withdrawn.

The annual election resulted in the choice of the following officers and committees: —

ALEXANDER AGASSIZ, *President.*
JOHN TROWBRIDGE, *Vice-President for Class I.*
GEORGE L. GOODALE, *Vice-President for Class II.*
AUGUSTUS LOWELL, *Vice-President for Class III.*
SAMUEL H. SCUDDER, *Corresponding Secretary.*
WILLIAM WATSON, *Recording Secretary.*
ELIOT C. CLARKE, *Treasurer.*
HENRY W. HAYNES, *Librarian.*

Councillors.

HENRY MITCHELL,
LEONARD P. KINNICUTT,
EDWARD H. HALL,
} of Class I.

HENRY P. BOWDITCH,
WILLIAM M. DAVIS,
BENJAMIN L. ROBINSON,
} of Class II.

JOHN E. HUDSON,
BARRETT WENDELL,
EDWARD ROBINSON,
} of Class III.

Member of the Committee of Finance.

AUGUSTUS LOWELL.

Rumford Committee.

ERASMUS D. LEAVITT, AMOS E. DOLBEAR,
EDWARD C. PICKERING, ARTHUR G. WEBSTER,
CHARLES R. CROSS, THEODORE W. RICHARDS,
THOMAS C. MENDENHALL.

C. M. Warren Committee.

FRANCIS H. STORER, HENRY W. HILL,
CHARLES L. JACKSON, LEONARD P. KINNICUTT,
SAMUEL CABOT, ARTHUR M. COMEY,
ROBERT H. RICHARDS.

The following gentlemen were elected members of the Academy: —

Harry Manley Goodwin, of Boston, to be a Resident Fellow in Class I., Section 2 (Physics).

Frank Arthur Laws, of Boston, to be a Resident Fellow in Class I., Section 2.

Walter Lewis Jennings, of Worcester, to be a Resident Fellow in Class I., Section 3 (Chemistry).

Abbott Lawrence Lowell, of Boston, to be a Resident Fellow in Class III., Section 3 (Political Economy and History).

William Osler, of Baltimore, to be an Associate Fellow in Class II., Section 4 (Medicine and Surgery), in place of the late Henry Newell Martin.

William Henry Welch, of Baltimore, to be an Associate Fellow in Class II., Section 4.

Horace Howard Furness, of Philadelphia, to be an Associate Fellow in Class III., Section 4 (Literature and the Fine Arts).

Edmund Clarence Stedman, of New York, to be an Associate Fellow in Class III., Section 4.

Percival Lowell gave an account of some "New Observations of the Planet Mercury."

The following papers were presented by title: —

On the Locus that represents an Automorphic Linear Transformation of a Bilinear Form. By William E. Story and Henry Taber.

Studies on the Central and Peripheral Nervous Systems of two Polychæte Annelids. By Margaret Lewis. Presented by E. L. Mark.

On the Temperature Coefficient of the Potential of the Calomel Electrode, with several different Supernatant Electrolytes. By T. W. Richards.

Note on the Rate of Dehydration of Crystallized Salts. By T. W. Richards.

On the 3, 4, 5 Tribromaniline and some Derivatives of unsymmetrical Tribrombenzol. By C. Loring Jackson and F. B. Gallivan.

On the Oxide of Dichlormethoxyquinonedibenzoylmethylacetal. By C. Loring Jackson and H. A. Torrey.

Eight hundred and ninety-second Meeting.

June 9, 1897.

The Academy met at the house of Francis Blake, at Weston.

The PRESIDENT in the chair.

The Chair announced the death of Alvan Graham Clark, Benjamin Eddy Cotting, and John Lowell, Resident Fellows.

The Chair read a letter from the Boston Society of Natural History in reference to inviting the American Association for the Advancement of Science to meet in Boston in 1898. This matter was referred to the executive officers.

The following papers were read: —

Certain Considerations concerning the Coinage of the Colony and the Public Bills of Credit of the Province of the Massachusetts Bay. By A. McFarland Davis.

Suggestions for the Development of the Arts and Sciences. By William R. Livermore.

The following papers were presented by title: —

The Orthopteran Group Scudderiæ. By S. H. Scudder.

Contributions from the Gray Herbarium of Harvard University. New Series. No. XII. — By M. L. Fernald. I. A Systematic Study of the United States and Mexican Species of Pectis. II. Some rare and undescribed Plants collected by Dr. Edward Palmer at Acapulco, Mexico. Presented by B. L. Robinson.

A Revision of the Atomic Weight of Cobalt. By T. W. Richards and G. P. Baxter.

A Revision of the Atomic Weight of Nickel. By T. W. Richards and A. S. Cushman.

Eight hundred and ninety-third Meeting.

October 13, 1897. — STATED MEETING.

VICE-PRESIDENT TROWBRIDGE in the chair.

The Chair announced the death of Theodore Lyman, Resident Fellow; Alfred Marshall Mayer, James Hammond Trumbull, Associate Fellows; Alfred Louis Olivier Legrand Des Cloizeaux, Victor Meyer, Julius von Sachs, and Johannes Japetus Smith Steenstrup, Foreign Honorary Members.

The Corresponding Secretary read a letter from Henry M. Howe, resigning his fellowship on account of removal to New York.

The following gentlemen were elected members of the Academy: —

James Mills Peirce, of Cambridge, as Resident Fellow in Class I., Section 1 (Mathematics and Astronomy).

Ira Nelson Hollis, of Cambridge, as Resident Fellow in Class I., Section 4 (Technology and Engineering).

Heinrich Brunner, of Berlin, as Foreign Honorary Member in Class III., Section 1 (Philosophy and Jurisprudence).

Frederic William Maitland, of Cambridge, as Foreign Honorary Member in Class III., Section 1.

Georg Morris Cohen Brandes, of Copenhagen, as Foreign Honorary Member in Class III., Section 4 (Literature and the Fine Arts).

Pierre Cécile Puvis de Chavannes, of Paris, as Foreign Honorary Member in Class III., Section 4.

Amos E. Dolbear read a paper entitled "Contrasted Properties of Matter and the Ether." Remarks on this communication were made by W. E. Story and A. G. Webster.

Eight hundred and ninety-fourth Meeting.

November 10, 1897.

In the absence of the regular presiding officers, MORRILL WYMAN was chosen President *pro tempore*.

The following letters were received: — from H. M. Goodwin, Ira N. Hollis, and Frank Arthur Laws, accepting Fellowship; from C. H. Fernald, declining Fellowship; from Horace Howard Furness, Edmund C. Stedman, and William H. Welch, acknowledging election as Associate Fellows; also letters announcing the death of Johannes Japetus Smith Steenstrup and Julius von Sachs, Foreign Honorary Members, of Alfred Ritter von Arneth, President of the Imperial Academy of Sciences, Vienna, and of Tommaso Vallauri, Member of the Royal Academy of Sciences, Turin.

On the motion of Eliot C. Clarke, the following resolution was adopted: —

Whereas, The Academy has received from the executors of the estate of John Lowell the sum of three thousand dollars, being a bequest, unrestricted as to its disposition, therefore be it

Resolved, That the Academy accepts said bequest with grateful appreciation of the generosity and trust of its late honored Resident Fellow, and will apply the same to the general purposes of the Academy, and that the Corresponding Secretary notify this action to Judge Lowell's executors.

Theodore Wm. Richards presented a paper on the Atomic Weights. Remarks on this subject were made by Arthur G. Webster.

The following paper was presented by title: —

On the Cuprosammonium Bromides and the Cuprammonium Sulphocyanates. By Theodore Wm. Richards and Benj. S. Merigold.

Eight hundred and ninety-fifth Meeting.

December 8, 1897.

The CORRESPONDING SECRETARY in the chair.

The Chair announced the death of Justin Winsor, Resident Fellow.

Letters were read from J. M. Peirce and F. W. Maitland, acknowledging election into the Academy; and from the Colonial

Society of Massachusetts, thanking the Academy for past courtesies, and requesting the use of its hall for the five stated meetings of the Society during the ensuing year.

On the motion of the Recording Secretary it was

Voted, To grant the request of the Colonial Society.

On the motion of the Treasurer, it was

Voted, That a Committee consisting of Messrs. Trowbridge, H. P. Bowditch, and Livermore be appointed on the part of the Academy to confer with any similar committee appointed on the part of the Massachusetts Historical Society, to ascertain whether the Academy can obtain suitable quarters in the new building of the Historical Society, and upon what terms, and to make any recommendation to the Academy which may seem desirable to said committee.

The following papers were read: —

On a recently discovered Egyptian Inscription relating to Israel. By Crawford H. Toy.

On some Properties of Fourfold Space. By William E. Story.

Eight hundred and ninety-sixth Meeting.

January 12, 1898. — STATED MEETING.

VICE-PRESIDENT TROWBRIDGE in the Chair.

The Chair announced the death of Francesco Brioschi, of Milan, and Don Pascual de Gayangos, of Madrid, Foreign Honorary Members.

The Corresponding Secretary read letters from the Superior Technical Institute of Milan, and the Royal Academy of Lincei of Rome, announcing the death of Francesco Brioschi, Foreign Honorary Member; and from P. Puvis de Chavannes, acknowledging his election as Foreign Honorary Member.

On the motion of the Corresponding Secretary it was

Voted, To meet on adjournment on the second Wednesday in February.

On the recommendation of the Rumford Committee, it was

Voted, To appropriate the sum of four hundred dollars ($400)

from the income of the Rumford Fund to W. C. Sabine for investigations in ultra-violet radiation.

On motion of Augustus Lowell it was

Voted, To authorize the Treasurer to make suitable arrangements with the Massachusetts Historical Society, for the accommodation of the Academy in the new building of the Society. It was also

Voted, To grant the free use of the hall of the Academy to the Historical Society for its regular meetings until the completion of the new building.

The following gentlemen were elected members of the Academy: —

George Edward Davenport, of Medford, to be a Resident Fellow in Class II., Section 2 (Botany).

John George Jack, of Boston, to be a Resident Fellow in Class II., Section 2.

John Merle Coulter, of Chicago, to be an Associate Fellow in Class II., Section 2, in place of the late Daniel Cady Eaton.

Douglas Houghton Campbell, of Palo Alto, to be an Associate Fellow in Class II., Section 2.

Elias Metschnikoff, of Paris, to be a Foreign Honorary Member in Class II., Section 3 (Zoölogy and Physiology).

The following papers were presented by title: —

The Thoracic Derivation of the Cardinal Veins in Swine. By G. H. Parker and C. H. Tozier.

The Analysis of the Action of the Vagus Nerve upon the Heart. Preliminary Notice. By L. J. J. Muskens. Presented by H. P. Bowditch.

On the Colored Compounds obtained from Sodic Alcoholates and Picrylchloride. By C. Loring Jackson and W. F. Boos.

The following papers were read: —

Changes in the Proportionate Diameters of the Shells of New England Mollusks. By Edward S. Morse.

A Probable Magnetic Telegraph of the Sixteenth Century. By Samuel Cabot.

On the Source of the X-Rays. By John Trowbridge.

Eight hundred and ninety-seventh Meeting.

February 9, 1898. — ADJOURNED STATED MEETING.

The Academy met at the house of John C. Ropes.

The RECORDING SECRETARY in the chair.

The following papers were read: —

The most recent Babylonian Explorations. By David G. Lyon.

The Seven Days' Battles near Richmond. By John C. Ropes.

Eight hundred and ninety-eighth Meeting.

March 9, 1898. — STATED MEETING.

The PRESIDENT in the chair.

The Corresponding Secretary read letters from George Edward Davenport, Douglas H. Campbell, John M. Coulter, and El. Metschnikoff, acknowledging election into the Academy; and from F. W. Taussig, resigning his Fellowship.

The chair announced the death of Alonzo Smith Kimball, Resident Fellow; William Augustus Rogers, Associate Fellow; and Rudolf Leuckart, Foreign Honorary Member.

The following gentlemen were elected members of the Academy: —

Charles Rockwell Lanman, of Cambridge, to be a Resident Fellow in Class III., Section 2 (Philology and Archæology).

Albert Heim, of Zurich, to be a Foreign Honorary Member in Class II., Section 1 (Geology, Mineralogy, and Physics of the Globe).

Friedrich von Recklinghausen, of Strassburg, to be a Foreign Honorary Member in Class II., Section 4 (Medicine and Surgery).

Ferdinand Brunetière, of Paris, to be a Foreign Honorary Member in Class III., Section 4 (Literature and the Fine Arts).

The President appointed the following Councillors to act as Nominating Committee: —

Leonard P. Kinnicutt, of Class I., William M. Davis, of Class II., and John E. Hudson, of Class III.

On the recommendation of the Rumford Committee, it was

Voted, To appropriate from the income of the Rumford Fund the sum of two hundred and fifty dollars ($250) to Professor A. A. Michelson, of Chicago, for an investigation regarding diffraction gratings. This is in addition to a sum of two hundred and fifty dollars already appropriated by the Rumford Committee from the funds at its own disposal.

The following papers were presented by title: —

Contributions from the Gray Herbarium of Harvard University. New Series. No. XIII. — By B. L. Robinson. I. Revision of the North American and Mexican Species of Mimosa. II. Revision of the North American Species of Neptunia.

An Inquiry into the Nature of Electrical Discharges in Air and Gases. By John Trowbridge.

On the Sources of Luminosity in the Electric Arc. By Henry Crew and Olin H. Basquin. Presented by C. R. Cross.

A Table of Atomic Weights. By Theodore William Richards.

On the Cause of the Retention and Release of Gases occluded by the Oxides of Metals. By Theodore William Richards.

Edward Atkinson read a paper, entitled "The Basis of the Science of Political Economy."

The question of printing a table of atomic weights every year, with T. W. Richards's corrections, was referred to the Committee of Publication.

Eight hundred and ninety-ninth Meeting.

April 13, 1898.

The Academy met at the house of Augustus Lowell.

The PRESIDENT in the chair.

The President announced the death of Sir Henry Bessemer, Foreign Honorary Member.

The following papers were read: —

The Theory of Coral Reefs. By Alexander Agassiz.

Occurrence of Native Copper at Franklin Furnace, New Jersey. By John E. Wolff.

Exhibition and Preliminary Account of a Collection of Microphotographs of Snow Crystals, made by W. A. Bentley. By John E. Wolff.

Albert A. Michelson exhibited and described a new form of spectroscope.

The following papers were read by title: —

Contributions from the Zoölogical Laboratory of the Museum of Comparative Zoölogy: A Contribution to the Study of Individual Variation in the Wings of Lepidoptera. By W. L. W. Field. Certain Sense Organs of the Proboscis of Rhynchobolus dibranchiatus. By A. Oppenheimer. Presented by E. L. Mark.

Contributions from the Gray Herbarium of Harvard University. New Series. No. XIV. — By J. M. Greenman. I. Revision of the Mexican and Central American Species of Galium and Relbunium. II. Diagnoses of New and Critical Mexican Phanerogams. Presented by B. L. Robinson.

An Absolute Measurement of the Thomson Effect in Copper. By R. O. King. Presented by E. H. Hall.

Note on Stokes's Theorem in Curvilinear Co-ordinates. By A. G. Webster.

Note on the Projective Group. By E. W. Rettger. Presented by Henry Taber.

On the Thermal Conductivities of Certain Poor Conductors. By B. O. Peirce and R. W. Willson.

AMERICAN ACADEMY OF ARTS AND SCIENCES.

REPORT OF THE COUNCIL. — PRESENTED MAY 11, 1898.

BIOGRAPHICAL NOTICES.

REPORT OF THE COUNCIL.

SINCE the Annual Meeting of May 12, 1897, the Academy has lost by death eighteen members: — seven Resident Fellows, Alvan Graham Clark, Benjamin Eddy Cotting, Alonzo Smith Kimball, John Lowell, Theodore Lyman, Jules Marcou, and Justin Winsor; three Associate Fellows, Alfred Marshall Mayer, William Augustus Rogers, and James Hammond Trumbull; and eight Foreign Honorary Members, Sir Henry Bessemer, Francesco Brioschi, Alfred Louis Olivier Legrand Des Cloiseaux, Pascual de Gayangos, Rudolf Leuckart, Victor Meyer, Julius von Sachs, and Johannes Japetus Smith Steenstrup.

BENJAMIN EDDY COTTING.

OUR late associate, Doctor BENJAMIN EDDY COTTING, enjoyed the rather rare opportunity of serving two Institutions for nearly fifty years. As Curator of the Lowell Institute, he held office for over half a century.

Add to this a professional life of sixty years, of which three-fourths was active, and we have a remarkable record. A calm temperament and continuous health enabled him to do all this with comparative ease to himself, and with benefit to others. He had a happy faculty of throwing off care, of working easily, of taking recreation between work. All of us remember him as a charming host, genial, bright, self-forgetful.

In making and keeping medicine respectable, honest and honorable, no doctor in Massachusetts ever played a more useful part. He might be styled the father, if not the founder, of the Massachusetts Medical Society, and was a financial backer and warm supporter of our local Medical Journal.

It was of great benefit, as well as a pleasure to him, to share the society and to follow the guidance of men of the sciences, other than

medical. He enjoyed immensely the position of active patron of the Lowell Lectures. He was very punctual and conscientious in his attendance at the opening of all these courses.

He was a constant attendant at, and an occasional contributor to the meetings of the Academy. He took a keen interest in the practical welfare of the society and of its members.

Dr. Cotting was a sceptic; his habit of mind was negative in belief. This applied to his own medical belief and to all the range of psychical events. He was a good observer, and clear-headed in his views. He was a positivist but not a dogmatist. He had many virtues which are called old-fashioned, and he was obstinate in his convictions.

His benevolence was self-sacrificing, and therein differed from common giving, — in faith nothing, in charity all. Those virtues which were fundamental in the Puritan remained vital in him; they were tempered by great kindness, but never weakened by concession. The frittering attrition of modern luxury and material advancement softens or weakens most characters, — a few, like our deceased brother's, remain sharp, clear-cut, in all time, like the basalt or granite of Egypt.

DAVID W. CHEEVER.

ALVAN GRAHAM CLARK.

IN St. Paul's cathedral is a simple tablet, and on it are these words, "Si monumentum requiris circumspice." To epitomize the life of a noted man is not an easy task. To remove the difficulty by entering upon a panegyric and an extension of details is less promising still. It remains, then, to carve a simple tablet by speaking briefly of his life and work, leaving to the good judgment and recollection of the reader the supreme prerogative of accurately filling in the details.

ALVAN GRAHAM CLARK was born in Fall River, Mass., July 10, 1832, and died in Cambridgeport, June 9, 1897. His father, Alvan Clark, was born in Ashfield, Mass., March 8, 1804, and was a descendant of Thomas Clark, one of the early Pilgrim settlers. His mother was Maria (Pease) Clark. He had two sisters and one brother, George Bassett Clark, who was born in Lowell, February 14, 1827, and died in Cambridge, January 2, 1892.

The life of Alvan G. Clark is largely involved in the establishment and progress of the optical firm of which he was a member. His father, Alvan Clark, the founder of the firm, was originally a portrait painter, and early developed an unusual capacity for delicate manipulation. His

attention was first called to lens making by an attempt of his son George to construct a telescope while a student at Andover. The books represented it as a very difficult thing. However, genius knows no limitations, and, without previous knowledge or discipline, the work was commenced and a telescope successfully made in the year 1846.

The work thus begun soon became a permanent occupation. Painting was exchanged for telescope making, and, about 1850, the house of Alvan Clark and Sons established. Both the sons inherited the father's skill, and entered into the work with him. Upon his death, the business was carried on by the sons together, and, upon the death of George, by Alvan alone.

Alvan Graham Clark was pre-eminently a self-made man. Inheriting to a remarkable degree the talents of his father, and with a fair amount of common school education, he carried lens making to the highest state of perfection the world has ever seen, so that a so called mechanical occupation was transferred to the realm of high art. But to make a good lens, good glass is necessary, and for a time the impossibility of obtaining good disks of large size seemed to present a barrier to the progress of telescope making. Fortunately this has been overcome in recent years by several European makers, notably by Feil of Paris and his successor Mantois, and it was upon this firm that Mr. Clark always relied.

In fact, disks sent by them were frequently rejected. Sometimes a lens would be nearly completed, and, with the gathering in of the last rays of light, a slight vein would be seen. Invariably the wellnigh completed lens was rejected and days of labor lost, for Mr. Clark would say, "I will keep up the standard of my work." As a result, the exquisite definition and clean cut images always confirmed the high standard of excellence set by the maker.

To make a lens is by no means an easy task. When one considers that not merely the chromatic and spherical aberration which relate to color and general figure proper have to be regarded, but also roundness, balance of figure, and several other considerations, it becomes evident that to construct a glass of the highest excellence is a very difficult task. To accomplish this, one must have not only a keen eye to see the defects, but good judgment and consummate skill to remove them without the incorporation of others.

One of the salient features of the Clarks' work was the method of local correction. This, although not wholly new in principle, was early adopted by them, and so extended and specialized that it has been

called distinctively the Clark method. It reached its highest manifestation and refinement as used by the subject of this sketch, and may briefly be described as follows. After a lens has been ground with emery, it is polished with rouge on a bed of pitch or coal tar, the spherometer being frequently applied to see that it is approaching the desired curvature. But, although the spherometer will easily detect an irregularity of the fifty-thousandth of an inch, it is far too crude to satisfy the highest demands of science, so that recourse must be had to some other alternative, for even an irregularity of a few millionths of an inch must not be disregarded. It is here that the method of local correction comes in to remove the difficulty. The lens is now carried to the dark room and tested on an artificial star, the eye being placed at the focus. If the light is uniformly distributed over the whole surface and all the rays come to a sharp point, the lens is in good figure, but such a condition would be extremely rare. Portions of the surface will almost inevitably be brighter than others, indicating slight irregularities of curvature. These must be eliminated by returning the lens to the tool and removing the slight elevations by judicious polishing at these points. The lens must also be frequently inserted in the telescope tube and tested on an actual star at night. After this, the special local work begins. This consists in taking some rouge upon the finger and changing the curvature by delicate abrasion at those points which need correction, frequently testing the lens to see that the desired result is being obtained. Here the work is carried to millionths of an inch, for in a 6-inch lens of 90 inches focus, all the rays of light must be shot through a focal point $\frac{1}{2400}$ of an inch in diameter. By tests with the polariscope, however, it may be found that the glass is not quite homogeneous in density, though without any definite flaw. In such a case the curvature must be changed to obviate this condition, so that the best lenses are not always true curves. As an instance of the amount of labor involved in local correction and testing, it may be mentioned that the great Lick telescope of 36 inches diameter was removed to the yard with its attendant risk, attached to the great tube, and tried on stars on fifty-two different nights, beside all the testing in the dark room. It becomes evident, then, that to see the defects, judge correctly of their character, and remove them without incorporating others, demands the keenest eye, the most delicate judgment, and exquisite manipulation, and it was here that Mr. Clark stood unrivalled.

Among the principal telescopes of the Clarks, and to which the subject of this sketch contributed the benefit of his judgment and skill, may

be mentioned one of 18¾ inches aperture for the Northwestern University, now located at Evanston, Ill. The next increase in size was marked by the construction of the Princeton refractor of 23 inches aperture. After this, a lens of 26 inches was made for the Naval Observatory at Washington, and one of about 26½ inches for the Leander McCormick Observatory of the University of Virginia. Then followed the 30-inch refractor for the Imperial Observatory at Pulkowa, for which a gold medal was awarded by the Russian government. Finally, as the last of the joint productions of the Clarks, came the famous Lick refractor of 36 inches aperture. It may be added that Mr. Alvan G. Clark did, practically, all the work on this lens, and brought it to its final perfection.

After the death of his brother George, he became sole manager of the firm. In this capacity he either made or superintended the construction of several great lenses, besides many smaller ones. These include the 20-inch lens for the Denver Observatory, one of 24 inches for Mr. Percival Lowell, the 24-inch Bruce Photographic telescope for the Harvard Observatory station at Arequipa, Peru, and, finally, as a crowning triumph, the great Yerkes lens of 40 inches in diameter.

This last he accompanied to its final destination, and superintended its mounting only a few days before his death. Beside his optical work, he was a member of several governmental eclipse expeditions, and also the discoverer of a number of close double stars. Nothing gave him more pleasure than the discovery of these difficult doubles, especially as they were all made with Clark glasses. One of his earliest and most important discoveries in this line was that of the companion of Sirius, in 1862, having been made in the yard adjoining the workshop with the newly constructed 18¾-inch lens before it was sent to Chicago. Turning on Sirius one evening, he detected something unusual, and shortly remarked that the star had a companion. This discovery, splendid enough in itself, was all the more so from the fact that, although irregularities in the motion of Sirius had been noticed and theorized upon, he knew nothing of them or of the predicted place of the companion. For this discovery, he received the Lalande Prize of the French Academy of Sciences.

He married, January 2, 1865, Mary Willard, daughter of Joseph Willard. She died on July 10, 1892. They had one son, Alvan, who died when a young man, and three daughters, still living.

In personal appearance and social intercourse Mr. Clark was unusually attractive. With finely cut features, of sympathetic nature and serene temper, he drew to himself a host of friends.

An hour at his workshop was an unusual pleasure, both for the scientific man as well as the ordinary individual, and no one was ever turned away.

His love for the best literature was intense. Shakespeare and the poets were his especial favorites, and, endowed with a remarkably retentive memory, he could quote from them almost indefinitely.

To him death was the inevitable sequel of life, the gate to be opened by a kind and all-wise Providence, and so without fear he met the future.

To make the most superb lenses, in which every slender ray of light shall be forced to bring its message of stellar history to a focal point, and to see these lenses steadily reach a size only considered possible with each successive achievement, — this was the ambition of Alvan Graham Clark, and in him it found complete fulfilment.

OLIVER C. WENDELL.

ALONZO SMITH KIMBALL.

DOCTOR ALONZO S. KIMBALL, who was for a quarter of a century Professor of Physics in the Worcester Polytechnic Institute, was born at Centre Harbor, New Hampshire, in 1843. He was prepared for college at New Hampton Academy, and was graduated from Amherst College in 1866. In 1871, he was called to the Worcester Polytechnic Institute, which had just graduated its first class. He organized the department of Physics, and the Institute was among the first in the country to provide systematic instruction in a physical laboratory. After seven or eight years of great activity and usefulness, shown alike in the development of the important department of which he had charge and in a series of valuable original contributions to physical science, he was, in 1879, attacked by a painful disease, which, in spite of the highest medical skill in both this country and Europe, proved to be incurable, and from the effects of which he died on December 2, 1897. Notwithstanding the steady progress of a malady which entailed nearly continuous suffering, Professor Kimball through all of these years discharged the constantly increasing duties of his position to the great satisfaction of the officers of the Institute and of his hundreds of pupils, to whom his life and work were always inspiring. In addition to his regular work in Worcester he was for several years a lecturer at Mount Holyoke College, of which institution he was also for many years and at the time of his death a trustee. While the Salisbury Laboratories of the Polytechnic Institute were being built, he spent a year in Europe, engaged in the

study of the best European establishments, and in selecting apparatus for the better equipment of the new building to which his department was to be transferred. While there he suffered from a more than usually acute attack, and submitted to a difficult and dangerous surgical operation which it was hoped might lead to a permanent recovery. Only temporary relief followed, however, and within the past five or six years several similar operations were performed with the same result. His work in the lecture room and laboratory was not seriously interrupted, although carried on under conditions that would have made it impossible with most men. When, ten or fifteen years ago, the creation of a new branch of Engineering began, Professor Kimball was not slow to appreciate its importance, and the Institute was among the first schools of applied science to offer a course in Electricity, with ample equipment of electrical machinery and other appliances necessary to its success. The management and development of this course, along with the course in pure physics, remained with him until about two years ago, when its magnitude had increased so greatly that it became necessary to set off the Electrical Engineering as a separate department, with a special Professor at its head. With lessened responsibility, his enthusiasm and for a time his activity greatly increased, but his enjoyment of the new conditions was unfortunately of short duration.

Professor Kimball was uncommonly skilful in experiment, possessing originality in design, and his work was done with that sense of refinement and precision which is essential to original research. Between the years 1875 and 1880, he published in various scientific journals a series of papers, each the result of wisely planned and carefully conducted experiment, and all of much value. The first was on "Sliding Friction," published in the American Journal of Science, March, 1876. It marked the beginning of an important investigation of the general subject of friction, the results of which were published in subsequent numbers of the same journal, in Van Nostrand's Engineering Magazine, and elsewhere. In these papers he shows that friction between sliding surfaces is independent of neither velocity nor pressure, experiment pointing to the existence of a maximum coefficient of friction depending on both velocity and pressure. During these years there were also other papers on the influence of temper upon the physical properties of steel, the effect of magnetization on the physical properties of iron, etc. There was also prepared and printed a small treatise on Thermodynamics, arranged especially for the use of his pupils, exhibiting much originality and clearness in method of presentation. In later years occasional pub-

lications were made of original investigations, which he was able to undertake at intervals in spite of the progress of the disease from which he was continually suffering. Among these was one on the influence of magnetic stress upon the capacity of an electric condenser, published in the Proceedings of this Academy, Volume XXI., page 193.

From the quality of Professor Kimball's work during this period, there can be little doubt that he would have achieved marked distinction in his chosen field but for the failure of his health, which he never recovered. From 1879 to his death, a period of nearly twenty years, his fight was against odds that must long ago have defeated any one endowed with only the average human courage and tenacity of purpose. Conscientiously discharging every duty that the day brought, he had little energy left for research work, although he published occasional papers, and was always anxious to utilize any temporary increment of vitality in that way. Professor Kimball was elected a Fellow of the American Academy of Arts and Sciences on May 27, 1884, but, although a member of numerous scientific societies, he was rarely seen at their meetings, his long illness thus standing in the way of those intimate personal and social relations with his confreres for which he was by nature so admirably fitted. His manner was charming, his good nature unceasing, and his instincts were fine and noble.

To those with whom he was associated in work, or who were otherwise privileged to know him intimately, his prolonged but splendidly heroic struggle with a fatal disease, together with the uniformly high standard of performance which that struggle did not sensibly affect, will ever remain an inspiring example of the best of human qualities.

T. C. MENDENHALL.

Other notices are unavoidably postponed.

Three Resident Fellows have resigned, one has been dropped, and the Academy has received an accession of nine Resident Fellows, six Associate Fellows, and eight Foreign Honorary Members.

The roll of the Academy, corrected to date, includes the names of 191 Resident Fellows, 96 Associate Fellows, and 66 Foreign Honorary Members.

BOSTON, May 11, 1898.

LIST

OF THE

FELLOWS AND FOREIGN HONORARY MEMBERS.

(Corrected to June 1, 1898.)

RESIDENT FELLOWS. — 194.

(Number limited to two hundred.)

Class I. — *Mathematical and Physical Sciences.* — 73.

Section I. — 16.

Mathematics and Astronomy.

Solon I. Bailey,	Cambridge.
Seth C. Chandler,	Cambridge.
J. Rayner Edmands,	Cambridge.
Gustavus Hay,	Boston.
Henry Mitchell,	Nantucket.
James Mills Peirce,	Cambridge.
Edward C. Pickering,	Cambridge.
John Ritchie, Jr.,	Boston.
John D. Runkle,	Brookline.
T. H. Safford,	Williamstown.
Edwin F. Sawyer,	Brighton.
Arthur Searle,	Cambridge.
William E. Story,	Worcester.
Henry Taber,	Worcester.
O. C. Wendell,	Cambridge.
P. S. Yendell,	Dorchester.

Section II. — 22.

Physics.

A. Graham Bell,	Washington.
Clarence J. Blake,	Boston.
Francis Blake,	Weston.
John H. Blake,	Boston.
Charles R. Cross,	Brookline.
Amos E. Dolbear,	Somerville.
H. M. Goodwin,	Boston.
Edwin H. Hall,	Cambridge.
Hammond V. Hayes,	Cambridge.
Silas W. Holman,	Boston.
William L. Hooper,	Somerville.
William W. Jacques,	Newton.
Frank A. Laws,	Boston.
T. C. Mendenhall,	Worcester.
Benjamin O. Peirce,	Cambridge.
A. Lawrence Rotch,	Boston.
Wallace C. Sabine,	Cambridge.
John S. Stone,	Boston.
Elihu Thomson,	Lynn.
John Trowbridge,	Cambridge.
A. G. Webster,	Worcester.
Robert W. Willson,	Cambridge.

Section III. — 21.

Chemistry.

Samuel Cabot,	Boston.
Arthur M. Comey,	Cambridge.
Thos. M. Drown,	So. Bethlehem, Pa.
Charles W. Eliot,	Cambridge.
Thomas Gaffield,	Boston.

Henry B. Hill,	Cambridge.
Charles L. Jackson,	Cambridge.
Walter L. Jennings,	Worcester.
Leonard P. Kinnicutt,	Worcester.
Charles F. Mabery,	Cleveland, O.
Arthur Michael,	Boston.
George D. Moore,	Worcester.
Charles E. Munroe,	Washington.
John U. Nef,	Chicago.
Robert H. Richards,	Boston.
Theodore W. Richards,	Cambridge.
Charles R. Sanger,	St. Louis.
Stephen P. Sharples,	Cambridge.
Francis H. Storer,	Boston.
Charles H. Wing,	Ledger, N. C.
Edward S. Wood,	Boston.

SECTION IV. — 14.

Technology and Engineering.

Eliot C. Clarke,	Boston.
Ira N. Hollis,	Cambridge.
Gaetano Lanza,	Boston.
E. D. Leavitt,	Cambridgeport.
William R. Livermore,	Boston.
Hiram F. Mills,	Lowell.
Cecil H. Peabody,	Boston.
Alfred P. Rockwell,	Manchester.
Andrew H. Russell,	Rock Island, Ill.
Peter Schwamb,	Arlington.
Charles S. Storrow,	Boston.
George F. Swain,	Boston.
William Watson,	Boston.
Morrill Wyman,	Cambridge.

CLASS II. — *Natural and Physiological Sciences.* — 63.

SECTION I. — 13.

Geology, Mineralogy, and Physics of the Globe.

H. H. Clayton,	Milton.
Algernon Coolidge,	Boston.
William O. Crosby,	Boston.
William M. Davis,	Cambridge.
Benj. K. Emerson,	Amherst.
O. W. Huntington,	Newport, R. I.
Robert T. Jackson,	Boston.
William H. Niles,	Cambridge.
John E. Pillsbury,	Boston.
Nathaniel S. Shaler,	Cambridge.
Warren Upham,	St. Paul, Minn.
Robert DeC. Ward,	Boston.
John E. Wolff,	Cambridge.

SECTION II. — 11.

Botany.

Geo. E. Davenport,	Medford.
William G. Farlow,	Cambridge.
Charles E. Faxon,	Boston.
George L. Goodale,	Cambridge.
H. H. Hunnewell,	Wellesley.
John G. Jack,	Boston.
B. L. Robinson,	Cambridge.
Charles S. Sargent,	Brookline.
Arthur B. Seymour,	Cambridge.
Charles J. Sprague,	Boston.
Roland Thaxter,	Cambridge.

SECTION III. — 24.

Zoölogy and Physiology.

Alexander Agassiz,	Cambridge.
Robert Amory,	Boston.
James M. Barnard,	Milton.
Henry P. Bowditch,	Boston.
William Brewster,	Cambridge.
Louis Cabot,	Brookline.
Samuel F. Clarke,	Williamstown.
W. T. Councilman,	Boston.
Charles B. Davenport,	Cambridge.
Harold C. Ernst,	Boston.
J. Walter Fewkes,	Washington, D.C.
Edward G. Gardiner,	Boston.
Samuel Henshaw,	Cambridge.
Alpheus Hyatt,	Cambridge.
John S. Kingsley,	Somerville.
Edward L. Mark,	Cambridge.
Charles S. Minot,	Boston.
Edward S. Morse,	Salem.

George H. Parker,	Cambridge.
James J. Putnam,	Boston.
Samuel H. Scudder,	Cambridge.
William T. Sedgwick,	Boston.
James C. White,	Boston.
William M. Woodworth,	Cambridge.

SECTION IV. — 15.

Medicine and Surgery.

Samuel L. Abbot,	Boston.
Edward H. Bradford,	Boston.
Arthur T. Cabot,	Boston.
David W. Cheever,	Boston.
Frank W. Draper,	Boston.
Thomas Dwight,	Boston.
Reginald H. Fitz,	Boston.
Charles F. Folsom,	Boston.
Frederick I. Knight,	Boston.
Francis Minot,	Hyde Park.
Samuel J. Mixter,	Boston.
W. L. Richardson,	Boston.
Theobald Smith,	Boston.
Henry P. Walcott,	Cambridge.
John C. Warren,	Boston.

CLASS III. — *Moral and Political Sciences.* — 58.

SECTION I. — 10.

Philosophy and Jurisprudence.

James B. Ames,	Cambridge.
Charles C. Everett,	Cambridge.
Horace Gray,	Boston.
John C. Gray,	Boston.
G. Stanley Hall,	Worcester.
Nathaniel Holmes,	Cambridge.
John E. Hudson,	Boston.
Francis C. Lowell,	Boston.
Josiah Royce,	Cambridge.
James B. Thayer,	Cambridge.

SECTION II. — 21.

Philology and Archæology.

William S. Appleton,	Boston.
Charles P. Bowditch,	Boston.
Lucien Carr,	Cambridge.
Franklin Carter,	Williamstown.
Joseph T. Clarke,	Boston.
Henry G. Denny,	Boston.
Epes S. Dixwell,	Cambridge.
William Everett,	Quincy.
William W. Goodwin,	Cambridge.
Henry W. Haynes,	Boston.
Charles R. Lanman,	Cambridge.
David G. Lyon,	Cambridge.
Bennett H. Nash,	Boston.
Frederick W. Putnam,	Cambridge.
Edward Robinson,	Boston.
F. B. Stephenson,	Boston.
Joseph H. Thayer,	Cambridge.
Crawford H. Toy,	Cambridge.
John W. White,	Cambridge.
John H. Wright,	Cambridge.
Edward J. Young,	Waltham.

SECTION III. — 15.

Political Economy and History.

Charles F. Adams,	Lincoln.
Edward Atkinson,	Boston.
Mellen Chamberlain,	Chelsea.
John Cummings,	Woburn.
Andrew M. Davis,	Cambridge.
Charles F. Dunbar,	Cambridge.
Samuel Eliot,	Boston.
John Fiske,	Cambridge.
A. C. Goodell,	Salem.
Henry C. Lodge,	Nahant.
A. Lawrence Lowell,	Boston.
Augustus Lowell,	Boston.
John C. Ropes,	Boston.
Denman W. Ross,	Cambridge.
Charles C. Smith,	Boston.

SECTION IV. — 12.

Literature and the Fine Arts.

Francis Bartlett,	Boston.
John Bartlett,	Cambridge.
George S. Boutwell,	Groton.
J. Elliot Cabot,	Brookline.
T. W. Higginson,	Cambridge.
George L. Kittredge,	Cambridge.
S. R. Koehler,	Boston.
Charles G. Loring,	Boston.
Percival Lowell,	Brookline.
Charles Eliot Norton,	Cambridge.
Horace E. Scudder,	Cambridge.
Barrett Wendell,	Boston.

ASSOCIATE FELLOWS. — 96.

(Number limited to one hundred. Elected as vacancies occur.)

Class I. — *Mathematical and Physical Sciences.* — 34.

Section I. — 14.

Mathematics and Astronomy.

Edward E. Barnard,	Chicago.
S. W. Burnham,	Chicago.
George Davidson,	San Francisco.
Fabian Franklin,	Baltimore.
Asaph Hall,	Cambridge.
George W. Hill,	Washington.
E. S. Holden,	Washington.
James E. Keeler,	Allegheny, Pa.
Emory McClintock,	New York.
Simon Newcomb,	Washington.
Charles L. Poor,	Baltimore.
George M. Searle,	Washington.
J. N. Stockwell,	Cleveland, O.
Chas. A. Young,	Princeton, N. J.

Section II. — 6.

Physics.

Carl Barus,	Providence, R.I.
J. Willard Gibbs,	New Haven.
S. P. Langley,	Washington.
A. A. Michelson,	Chicago.
Ogden N. Rood,	New York.
H. A. Rowland,	Baltimore.

Section III. — 7.

Chemistry.

Wolcott Gibbs,	Newport, R.I.
Frank A. Gooch,	New Haven.
S. W. Johnson,	New Haven.
J. W. Mallet,	Charlottesville, Va.
E. W. Morley,	Cleveland, O.
J. M. Ordway,	New Orleans.
Ira Remsen,	Baltimore.

Section IV. — 7.

Technology and Engineering.

Henry L. Abbot,	New York.
Cyrus B. Comstock,	Washington.
W. P. Craighill,	Washington.
F. R. Hutton,	New York.
George S. Morison,	Chicago.
William Sellers,	Philadelphia.
Robt. S. Woodward,	New York.

Class II. — *Natural and Physiological Sciences.* — 33.

Section I. — 15.

Geology, Mineralogy, and Physics of the Globe.

Cleveland Abbe,	Washington.
George J. Brush,	New Haven.
Edward S. Dana,	New Haven.
Walter G. Davis,	Cordova, Arg.
Sir J. W. Dawson,	Montreal.
G. K. Gilbert,	Washington.
James Hall,	Albany, N.Y.
Clarence King,	New York.
Joseph LeConte,	Berkeley, Cal.
J. Peter Lesley,	Milton, Mass.
S. L. Penfield,	New Haven.
J. W. Powell,	Washington.
R. Pumpelly,	Newport, R.I.
A. R. C. Selwyn,	Ottawa.
G. C. Swallow,	Columbia, Mo.

SECTION II. — 5.

Botany.

D. H. Campbell, Palo Alto, Cal.
A. W. Chapman, Apalachicola, Fla.
J. M. Coulter, Chicago.
W. Trelease, St. Louis.
John D. Smith, Baltimore.

SECTION III. — 6.

Zoölogy and Physiology.

Joel A. Allen, New York.
W. K. Brooks, Baltimore.
O. C. Marsh, New Haven.
S. Weir Mitchell, Philadelphia.
A. S. Packard, Providence, R.I.
A. E. Verrill, New Haven.

SECTION IV. — 7.

Medicine and Surgery.

John S. Billings, New York.
Jacob M. Da Costa, Philadelphia.
W. A. Hammond, New York.
William Osler, Baltimore.
Alfred Stillé, Philadelphia.
Wm. H. Welch, Baltimore.
H. C. Wood, Philadelphia.

CLASS III. — *Moral and Political Sciences.* — 29.

SECTION I. — 6.

Philosophy and Jurisprudence.

James C. Carter, New York.
T. M. Cooley, Ann Arbor, Mich.
D. R. Goodwin, Philadelphia.
Charles S. Peirce, New York.
T. R. Pynchon, Hartford, Conn.
Jeremiah Smith, Cambridge.

SECTION II. — 7.

Philology and Archæology.

A. N. Arnold, Pawtuxet, R.I.
Timothy Dwight, New Haven.
B. L. Gildersleeve, Baltimore.
D. C. Gilman, Baltimore.
T. R. Lounsbury, New Haven.
E. E. Salisbury, New Haven.
A. D. White, Ithaca, N.Y.

SECTION III. — 8.

Political Economy and History.

Henry Adams, Washington.
G. P. Fisher, New Haven.
M. F. Force, Cincinnati.
H. E. von Holst, Chicago.
Henry C. Lea, Philadelphia.
Edward J. Phelps, Burlington, Vt.
W. G. Sumner, New Haven.
David A. Wells, Norwich, Conn.

SECTION IV. — 8.

Literature and the Fine Arts.

James B. Angell, Ann Arbor, Mich.
L. P. di Cesnola, New York.
F. E. Church, New York.
H. H. Furness, Philadelphia.
R. S. Greenough, Florence.
Augustus St. Gaudens, New York.
E. C. Stedman, Bronxville, N.Y.
W. R. Ware, New York.

FOREIGN HONORARY MEMBERS. — 66.

(Number limited to seventy-five. Elected as vacancies occur.)

Class I. — *Mathematical and Physical Sciences.* — 20.

Section I. — 7.

Mathematics and Astronomy.

Arthur Auwers,	Berlin.
George H. Darwin,	Cambridge.
H. A. E. A. Faye,	Paris.
Charles Hermite,	Paris.
William Huggins,	London.
Otto Struve,	Karlsruhe.
H. C. Vogel,	Potsdam.

Section II. — 4.

Physics.

Ludwig Boltzmann,	Vienna.
A. Cornu,	Paris.
Lord Rayleigh,	Witham.
Sir G. G. Stokes, Bart.,	Cambridge.

Section III. — 7.

Chemistry.

Adolf Baeyer,	Munich.
Marcellin Berthelot,	Paris.
Robert Bunsen,	Heidelberg.
J. H. van't Hoff,	Berlin.
D. Mendeleeff,	St. Petersburg.
Sir H. E. Roscoe,	London.
Julius Thomsen,	Copenhagen.

Section IV. — 2.

Technology and Engineering.

Lord Kelvin,	Glasgow.
Maurice Lévy,	Paris.

Class II. — *Natural and Physiological Sciences.* — 23.

Section I. — 5.

Geology, Mineralogy, and Physics of the Globe.

Albert Heim,	Zurich.
A. E. Nordenskiöld,	Stockholm.
C. F. Rammelsberg,	Berlin.
Henry C. Sorby,	Sheffield.
Heinrich Wild,	Zurich.

Section II. — 6.

Botany.

J. G. Agardh,	Lund.
E. Bornet,	Paris.
Sir Joseph D. Hooker,	Sunningdale.
W. Pfeffer,	Leipsic.
Solms-Laubach,	Strassburg.
Eduard Strasburger,	Bonn.

SECTION III. — 7.

Zoölogy and Physiology.

Michael Foster,	Cambridge.
Carl Gegenbauer,	Heidelberg.
Ludimar Hermann,	Königsberg.
Albrecht Kölliker,	Würzburg.
A. Kovalevsky,	St. Petersburg.
Lacaze-Duthiers,	Paris.
Elias Metschnikoff,	Paris.

SECTION IV. — 5.

Medicine and Surgery.

W. Kühne,	Heidelberg.
Lord Lister,	London.
Sir James Paget, Bart.,	London.
F. v. Recklinghausen,	Strassburg.
Rudolph Virchow,	Berlin.

CLASS III. — *Moral and Political Sciences.* — 23.

SECTION I. — 5.

Philosophy and Jurisprudence.

Heinrich Brunner,	Berlin.
F. W. Maitland,	Cambridge.
James Martineau,	London.
Sir Frederick Pollock,	Oxford.
Henry Sidgwick,	Cambridge.

SECTION II. — 7.

Philology and Archæology.

Ingram Bywater,	Oxford.
W. Dörpfeld,	Athens.
Sir John Evans,	Hemel Hempstead.
J. W. A. Kirchhoff,	Berlin.
G. C. C. Maspero,	Paris.
Max Müller,	Oxford.
Karl Weinhold,	Berlin.

SECTION III. — 5.

Political Economy and History.

Duc de Broglie,	Paris.
James Bryce,	Oxford.
Hermann Grimm,	Berlin.
Theodor Mommsen,	Berlin.
William Stubbs,	Oxford.

SECTION IV. — 6.

Literature and the Fine Arts.

Georg Brandes,	Copenhagen.
F. Brunetière,	Paris.
Jean Léon Gérôme,	Paris.
P. Puvis de Chavannes,	Paris.
John Ruskin,	Coniston.
Leslie Stephen,	London.

STATUTES AND STANDING VOTES.

STATUTES.

Adopted May 30, 1854: *amended September* 8, 1857, *November* 12, 1862, *May* 24, 1864, *November* 9, 1870, *May* 27, 1873, *January* 26, 1876, *June* 16, 1886, *October* 8, 1890, *January* 11 *and May* 10, 1893, *April* 11, *May* 9, *and October* 10, 1894, *and March* 13, *April* 10, *and May* 8, 1895.

CHAPTER I.

Of Fellows and Foreign Honorary Members.

1. The Academy consists of *Fellows* and *Foreign Honorary Members*. They are arranged in three Classes, according to the Arts and Sciences in which they are severally proficient, viz.: Class I. The Mathematical and Physical Sciences; — Class II. The Natural and Physiological Sciences; — Class III. The Moral and Political Sciences. Each Class is divided into four Sections, viz.: Class I., Section 1. Mathematics and Astronomy; — Section 2. Physics; — Section 3. Chemistry; — Section 4. Technology and Engineering. Class II., Section 1. Geology, Mineralogy, and Physics of the Globe; — Section 2. Botany; — Section 3. Zoölogy and Physiology; — Section 4. Medicine and Surgery. Class III., Section 1. Philosophy and Jurisprudence; — Section 2. Philology and Archæology; — Section 3. Political Economy and History; — Section 4. Literature and the Fine Arts.

2. Fellows, resident in the State of Massachusetts, only, may vote at the meetings of the Academy.* Each Resident Fellow shall pay an admission fee of ten dollars and such annual assessment, not exceeding ten dollars, as shall be voted by the Academy at each Annual Meeting.

* The number of Resident Fellows is limited by the Charter to 200.

3. Fellows residing out of the State of Massachusetts shall be known and distinguished as Associate Fellows. They shall not be liable to the payment of any fees or annual dues, but on removing within the State shall be admitted to the privileges,* and be subject to the obligations, of Resident Fellows. The number of Associate Fellows shall not exceed *one hundred*, of whom there shall not be more than *forty* in either of the three Classes of the Academy.

4. The number of Foreign Honorary Members shall not exceed *seventy-five;* and they shall be chosen from among persons most eminent in foreign countries for their discoveries and attainments in either of the three departments of knowledge above enumerated. And there shall not be more than *thirty* Foreign Members in either of these departments.

CHAPTER II.

Of Officers.

1. There shall be a President, three Vice-Presidents, one for each Class, a Corresponding Secretary, a Recording Secretary, a Treasurer, and a Librarian, which officers shall be annually elected, by ballot, at the Annual Meeting, on the second Wednesday in May.

2. At the same time, and in the same manner, nine Councillors shall be elected, three from each Class of the Academy, but the same Fellows shall not be eligible on more than three successive years. These nine Councillors, with the President, the three Vice-Presidents, the two Secretaries, the Treasurer, and the Librarian, shall constitute the Council. It shall be the duty of this Council to exercise a discreet supervision over all nominations and elections. With the consent of the Fellow interested, they shall have power to make transfers between the several Sections of the same Class, reporting their action to the Academy.

3. If any office shall become vacant during the year, the vacancy shall be filled by a new election, and at the next stated meeting, or at a meeting called for this purpose.

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* Associate Fellows may attend, but cannot vote, at meetings of the Academy. See Chapter I. 2.

CHAPTER III.

Of Nominations of Officers.

1. At the stated meeting in March, the President shall appoint from the next retiring Councillors a Nominating Committee of three Fellows, one for each class.

2. It shall be the duty of this Nominating Committee to prepare a list of candidates for the offices of President, Vice-Presidents, Corresponding Secretary, Recording Secretary, Treasurer, Librarian, Councillors, and the Standing Committees which are chosen by ballot; and to cause this list to be sent by mail to all the Resident Fellows of the Academy not later than four weeks before the Annual Meeting.

3. Independent nominations for any office, signed by at least five Resident Fellows and received by the Recording Secretary not less than ten days before the Annual Meeting, shall be inserted in the call for the Annual Meeting, which shall then be issued not later than one week before that meeting.

4. The Recording Secretary shall prepare for use, in voting at the Annual Meeting, a ballot containing the names of all persons nominated for office under the conditions given above.

5. When an office is to be filled at any other time than at the Annual Meeting, the President shall appoint a Nominating Committee, in accordance with the provisions of Section 1, which shall announce its nomination in the manner prescribed in Section 2 at least two weeks before the time of election. Independent nominations, signed by at least five Resident Fellows and received by the Recording Secretary not later than one week before the meeting for election, shall be inserted in the call for that meeting.

CHAPTER IV.

Of the President.

1. It shall be the duty of the President, and, in his absence, of the senior Vice-President present, or next officer in order as above enumerated, to preside at the meetings of the Academy; to summon extraordinary meetings, upon any urgent occasion; and to execute or see to the execution of the Statutes of the

Academy. Length of continuous membership in the Academy shall determine the seniority of the Vice-Presidents.

2. The President, or, in his absence, the next officer as above enumerated, is empowered to draw upon the Treasurer for such sums of money as the Academy shall direct. Bills presented on account of the Library, or the Publications of the Academy, must be previously approved by the respective committees on these departments.

3. The President, or, in his absence, the next officer as above enumerated, shall nominate members to serve on the different committees of the Academy which are not chosen by ballot.

4. Any deed or writing to which the common seal is to be affixed shall be signed and sealed by the President, when thereto authorized by the Academy.

CHAPTER V.

Of Standing Committees.

1. At the Annual Meeting there shall be chosen the following Standing Committees, to serve for the year ensuing, viz.: —

2. The Committee of Finance, to consist of the President, Treasurer, and one Fellow chosen by ballot, who shall have charge of the investment and management of the funds and trusts of the Academy. The general appropriations for the expenditures of the Academy shall be moved by this Committee at the Annual Meeting, and all special appropriations from the general and publication funds shall be referred to or proposed by this Committee.

3. The Rumford Committee, of seven Fellows, to be chosen by ballot, who shall consider and report on all applications and claims for the Rumford Premium, also on all appropriations from the income of the Rumford Fund, and generally see to the due and proper execution of this trust.

4. The C. M. Warren Committee, of seven Fellows, to be chosen by ballot, who shall consider and report on all applications for appropriations from the income of the C. M. Warren Fund, and generally see to the due and proper execution of this trust.

5. The Committee of Publication, of three Fellows, to whom all memoirs submitted to the Academy shall be referred, and to

whom the printing of memoirs accepted for publication shall be intrusted.

6. The Committee on the Library, of three Fellows, who shall examine the Library, and make an annual report on its condition and management.

7. An Auditing Committee, of two Fellows, for auditing the accounts of the Treasurer.

CHAPTER VI.

Of the Secretaries.

1. The Corresponding Secretary shall conduct the correspondence of the Academy, recording or making an entry of all letters written in its name, and preserving on file all letters which are received; and at each meeting he shall present the letters which have been addressed to the Academy since the last meeting. With the advice and consent of the President, he may effect exchanges with other scientific associations, and also distribute copies of the publications of the Academy among the Associate Fellows and Foreign Honorary Members, as shall be deemed expedient; making a report of his proceedings at the Annual Meeting. Under the direction of the Council for Nomination, he shall keep a list of the Fellows, Associate Fellows, and Foreign Honorary Members, arranged in their Classes and in Sections in respect to the special sciences in which they are severally proficient; and he shall act as secretary to the Council.

2. The Recording Secretary shall have charge of the Charter and Statute-book, journals, and all literary papers belonging to the Academy. He shall record the proceedings of the Academy at its meetings; and after each meeting is duly opened, he shall read the record of the preceding meeting. He shall notify the meetings of the Academy, and apprise committees of their appointment. He shall post up in the Hall a list of the persons nominated for election into the Academy; and when any individual is chosen, he shall insert in the record the names of the Fellows by whom he was nominated.

3. The two Secretaries, with the Chairman of the Committee of Publication, shall have authority to publish such of the proceedings of the Academy as as may seem to them calculated to promote the interests of science.

CHAPTER VII.

Of the Treasurer.

1. The Treasurer shall give such security for the trust reposed in him as the Academy shall require.

2. He shall receive officially all moneys due or payable, and all bequests or donations made to the Academy, and by order of the President or presiding officer shall pay such sums as the Academy may direct. He shall keep an account of all receipts and expenditures; shall submit his accounts to the Auditing Committee; and shall report the same at the expiration of his term of office.

3. The Treasurer shall keep a separate account of the income and appropriation of the Rumford Fund, and report the same annually.

4. All moneys which there shall not be present occasion to expend shall be invested by the Treasurer, under the direction of the Finance Committee, on such securities as the Academy shall direct.

CHAPTER VIII.

Of the Librarian and Library.

1. It shall be the duty of the Librarian to take charge of the books, to keep a correct catalogue of same, and to provide for the delivery of books from the Library. He shall also have the custody of the publications of the Academy.

2. The Librarian, in conjunction with the Committee on the Library, shall have authority to expend, as they may deem expedient, such sums as may be appropriated, either from the Rumford or the General Fund of the Academy, for the purchase of books, and for defraying other necessary expenses connected with the Library. They shall have authority to propose rules and regulations concerning the circulation, return, and safe-keeping of books; and to appoint such agents for these purposes as they may think necessary.

3. To all books in the Library procured from the income of the Rumford Fund, the Librarian shall cause a stamp or label to be affixed, expressing the fact that they were so procured.

4. Every person who takes a book from the Library shall give a receipt for the same to the Librarian or his assistant.

5. Every book shall be returned in good order, regard being had to the necessary wear of the book with good usage. And if any book shall be lost or injured, the person to whom it stands charged shall replace it by a new volume or set, if it belongs to a set, or pay the current price of the volume or set to the Librarian; and thereupon the remainder of the set, if the volume belonged to a set, shall be delivered to the person so paying for the same.

6. All books shall be returned to the Library for examination at least one week before the Annual Meeting.

CHAPTER IX.

Of Meetings.

1. There shall be annually four stated meetings of the Academy; namely, on the second Wednesday in May (the Annual Meeting), on the second Wednesday in October, on the second Wednesday in January, and on the second Wednesday in March. At these meetings only, or at meetings adjourned from these and regularly notified, shall appropriations of money be made, or alterations of the statutes or standing votes of the Academy be effected.

2. Fifteen Fellows shall constitute a quorum for the transaction of business at a stated meeting. Seven Fellows shall be sufficient to constitute a meeting for scientific communications and discussions.

3. The Recording Secretary shall notify the meetings of the Academy to each Fellow residing in Boston and the vicinity; and he may cause the meetings to be advertised, whenever he deems such further notice to be needful.

CHAPTER X.

Of the Election of Fellows and Honorary Members.

1. Elections shall be made by ballot, and only at stated meetings.

2. Candidates for election as Resident Fellows must be proposed by two or more Resident Fellows, in a recommendation signed by them, specifying the Section to which the nomination is made, which recommendation shall be transmitted to the Corresponding Secretary, and by him referred to the Council for Nomination. No person recommended shall be reported by the Council as a candidate for election, unless he shall have received a written approval, signed at a meeting of the Council by at least seven of its members. All nominations thus approved shall be read to the Academy at a stated meeting, and shall then stand on the nomination list during the interval between two stated meetings, and until the balloting. No person shall be elected a Resident Fellow, unless he shall have been resident in this Commonwealth one year next preceding his election. If any person elected a Resident Fellow shall neglect for one year to pay his admission fee, his election shall be void; and if any Resident Fellow shall neglect to pay his annual assessments for two years, provided that his attention shall have been called to this article, he shall be deemed to have abandoned his Fellowship; but it shall be in the power of the Treasurer, with the consent of the Council, to dispense (*sub silentio*) with the payment both of the admission fee and of the assessments, whenever in any special instance he shall think it advisable so to do.

3. The nomination of Associate Fellows shall take place in the manner prescribed in reference to Resident Fellows; and after such nomination shall have been publicly read at a stated meeting previous to that when the balloting takes place, it shall be referred to the Council for Nomination; and a written approval, authorized and signed at a meeting of said Council by at least seven of its members, shall be requisite to entitle the candidate to be balloted for. The Council may in like manner originate nominations of Associate Fellows, which must be read at a stated meeting previous to the election, and be exposed on the nomination list during the interval.

4. Foreign Honorary Members shall be chosen only after a nomination made at a meeting of the Council, signed at the time by at least seven of its members, and read at a stated meeting previous to that on which the balloting takes place.

5. Three fourths of the ballots cast must be affirmative, and the number of affirmative ballots must amount to eleven to effect an election of Fellows or Foreign Honorary Members.

6. Each Section of the Academy is empowered to present lists of persons deemed best qualified to fill vacancies occurring in the number of Foreign Honorary Members or Associate Fellows allotted to it; and such lists, after being read at a stated meeting, shall be referred to the Council for Nomination.

7. If, in the opinion of a majority of the entire Council, any Fellow — Resident or Associate — shall have rendered himself unworthy of a place in the Academy, the Council shall recommend to the Academy the termination of his Fellowship; and provided that a majority of two thirds of the Fellows at a stated meeting, consisting of not less than fifty Fellows, shall adopt this recommendation, his name shall be stricken off the roll of Fellows.

CHAPTER XI.

Of Amendments of the Statutes.

1. All proposed alterations of the Statutes, or additions to them, shall be referred to a committee, and, on their report at a subsequent meeting, shall require for enactment a majority of two thirds of the members present, and at least eighteen affirmative votes.

2. Standing Votes may be passed, amended, or rescinded, at any stated meeting, by a majority of two thirds of the members present. They may be suspended by a unanimous vote.

CHAPTER XII.

Of Literary Performances.

1. The Academy will not express its judgment on literary or scientific memoirs or performances submitted to it, or included in its publications.

STANDING VOTES.

1. Communications of which notice had been given to the Secretary shall take precedence of those not so notified.

2. Resident Fellows who have paid all fees and dues chargeable to them are entitled to receive one copy of each volume or article printed by the Academy, on application to the Librarian personally or by written order, within two years from the date of publication. And the current issues of the Proceedings shall be supplied, when ready for publication, free of charge, to all the Fellows and members of the Academy who desire to receive them.

3. The Committee of Publication shall fix from time to time the price at which the publications of the Academy may be sold. But members may be supplied at half this price with volumes which they are not entitled to receive free, and which are needed to complete their sets.

4. Two hundred extra copies of each paper accepted for publication in the Memoirs or Proceedings of the Academy shall be placed at the disposal of the author, free of charge.

5. Resident Fellows may borrow and have out from the Library six volumes at any one time, and may retain the same for three months, and no longer.

6. Upon special application, and for adequate reasons assigned, the Librarian may permit a larger number of volumes, not exceeding twelve, to be drawn from the Library for a limited period.

7. Works published in numbers, when unbound, shall not be taken from the Hall of the Academy, except by special leave of the Librarian.

8. Books, publications, or apparatus shall be procured from the income of the Rumford Fund only on the certificate of the Rumford Committee that they, in their opinion, will best facilitate and encourage the making of discoveries and improvements which may merit the Rumford Premium.

9. The Annual Meeting and the other stated meetings shall be holden at eight o'clock, P. M.

10. A meeting for receiving and discussing scientific communications may be held on the second Wednesday of each month not appointed for stated meetings, excepting July, August, and September.

RUMFORD PREMIUM.

In conformity with the terms of the gift of Benjamin, Count Rumford, granting a certain fund to the American Academy of Arts and Sciences, and with a decree of the Supreme Judicial Court for carrying into effect the general charitable intent and purpose of Count Rumford, as expressed in his letter of gift, the Academy is empowered to make from the income of said fund, as it now exists, at any Annual Meeting, an award of a gold and silver medal, being together of the intrinsic value of three hundred dollars, as a premium to the author of any important discovery or useful improvement in light or in heat, which shall have been made and published by printing, or in any way made known to the public, in any part of the continent of America, or any of the American islands; preference being always given to such discoveries as shall, in the opinion of the Academy, tend most to promote the good of mankind; and to add to such medals, as a further premium for such discovery and improvement, if the Academy see fit so to do, a sum of money not exceeding three hundred dollars.

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